

**WHAT IS CLAIMED IS:**

1. A system for hydraulically raising and lowering a boom, said system comprising: a boom pivotally connected to a boom support, a hydraulic circuit connected to said boom and said boom support and configured to controllably raise and lower said boom relative to said boom support, and at least one assist cylinder comprising a first end pivotally secured to said boom, a second end pivotally secured to said boom support, and a substantially hollow interior containing a compressible medium therein.

2. The system of Claim 1 wherein said hydraulic circuit comprises at least one hydraulic cylinder, each said hydraulic cylinder comprising an upper end pivotally secured to said boom and a lower end pivotally secured to said boom support.

3. The system of Claim 2 wherein each said hydraulic cylinder comprises a chamber, a piston movably mounted in said chamber, and a rod secured to one side of said piston, said rod sealably extending from an exit end of said chamber and having a distal end comprising said upper end, said chamber having a closed end generally opposite said exit end, said lower end being external of said closed end, a first dynamic interior portion of said chamber being located between said closed end and said piston, a second dynamic interior portion being located between said one side and said exit end, each of said first

and second dynamic interior portions containing hydraulic fluid and being in fluid communication with said hydraulic circuit.

4. The system of Claim 1 wherein said compressible medium comprises a gas.

5. The system of Claim 4 wherein said gas is selected from the group of gases consisting of: nitrogen, other non-combustible gases, and combinations thereof.

6. The system of Claim 4 wherein said gas is nitrogen.

7. The system of Claim 1 wherein said assist cylinder further comprises a movable piston sealably mounted about its periphery within said interior and a rod secured on one side of said piston and extending from said interior at an exit end thereof, said rod having a distal end comprising said first end, said interior further comprising a closed end generally opposite said exit end.

8. The system of Claim 7 wherein said interior and said piston define a dynamic chamber located between said closed end and said piston.

9. The system of Claim 8 wherein said rod comprises a chamber therein, said chamber being in fluid communication with said dynamic chamber through at least one medial vent in said piston.

10. The system of Claim 9 wherein said compressible medium is caused to be compressed within a space defined by said chamber and said dynamic chamber being in fluid communication with each other when said hydraulic circuit is employed to lower said boom, said compressible medium

being compressed to a pressure that generates a potential energy within said assist cylinder sufficient to assist said hydraulic circuit to subsequently raise said boom when said potential energy is converted to kinetic energy that causes said rod to extend from said interior due to the pressure in said space exerted on said piston, in order to exert generally upward force on said boom at said first end.

11. The system of Claim 8 wherein said compressible medium is caused to be compressed within said dynamic chamber when said hydraulic circuit is employed to lower said boom, said compressible medium being compressed to a pressure that generates a potential energy within said assist cylinder sufficient to assist said hydraulic circuit to subsequently raise said boom when said potential energy is converted to kinetic energy that causes said rod to extend from said interior due to the pressure in said dynamic chamber exerted on said piston, in order to exert generally upward force on said boom at said first end.

12. The system of Claim 7 wherein said interior comprises an inner diameter of between about 5 inches and about 11½ inches.

13. The system of Claim 12 wherein said inner diameter is about 10 inches.

14. The system of Claim 12 wherein said inner diameter is about 6½ inches.

15. The system of Claim 9 wherein said chamber comprises an inner diameter between about 2 inches and about 6 inches.

16. The system of Claim 15 wherein said inner diameter is about 4½ inches.

17. The system of Claim 1 wherein said assist cylinder has a stroke distance of between about 35 inches and about 70 inches.

18. The system of Claim 17 wherein said stroke distance is about 49 inches.

19. The system of Claim 10 or Claim 11 wherein said potential energy generated is converted to exert force measuring between about 20,000 lb<sub>f</sub> and 70,000 lb<sub>f</sub>.

20. The system of Claim 7 further comprising an expansion tank fluidly connected to said interior, said expansion tank containing additional amounts of said compressible medium.

21. The system of Claim 20 further comprising a charge line and a relief line, said charge line fluidly connecting said tank to said interior at a first port proximate said closed end, said charge line being configured to charge said interior with said compressible medium from said tank to achieve a desired minimum pressure therein relative to the location of said piston therein, said relief line fluidly connecting said tank to said interior at a second port proximate said closed end, said relief line being configured to remove said compressible medium from said interior to said tank through said second port when actual pressure in said interior exceeds a threshold pressure.

22. The system of Claim 21 further comprising a pump on said charge line between said tank and said first port, said pump being configured to transfer said compressible medium from said tank to said interior.

23. The system of Claim 22 further comprising a check valve on said charge line configured to permit fluid flow through said charge line only in the direction of said first port.

24. The system of Claim 21 further comprising a relief valve on said relief line, said relief valve being configured to open to allow said compressible medium to exit from said second port when said interior reaches said threshold pressure.

25. The system of Claim 3 wherein each said hydraulic cylinder comprises a double acting hydraulic cylinder, said hydraulic circuit comprising a hydraulic fluid reservoir in fluid communication with at least one hydraulic pump, said hydraulic pump configured to selectively supply hydraulic fluid either to said first dynamic interior portion or said second dynamic interior portion through hydraulic lines connecting said pump to said first and second dynamic interior portions, additional hydraulic lines being provided to connect said first and second dynamic interior portions to said reservoir for directing said hydraulic fluid from the one of said first and second dynamic interior portions not supplied with hydraulic fluid by said hydraulic pump.

26. The system of Claim 1 wherein said hydraulic circuit comprises at least one hydraulic cylinder, each said hydraulic cylinder comprising an upper end

pivotally secured to said boom and a lower end pivotally secured to said boom support, said hydraulic cylinder further comprising a chamber, a piston movably mounted in said chamber and a rod secured to one side of said piston, said rod extending from an exit end of said chamber and having a distal end comprising said upper end, said chamber having a closed end generally opposite said exit end, said lower end being external of said closed end, at least a first dynamic interior portion of said chamber being located between said closed end and said piston, said first dynamic interior portion containing hydraulic fluid and being in fluid communication with said hydraulic circuit, said assist cylinder further comprising a movable assist piston sealably mounted within said interior, an assist rod secured on one side of said assist piston and extending from said interior at an assist cylinder exit end, said assist rod having a distal end comprising said first end, said interior further comprising an assist cylinder closed end generally opposite said assist cylinder exit end, said interior and said assist piston defining a dynamic chamber located between said assist cylinder closed end and said assist piston, said compressible medium being compressed within said dynamic chamber when said hydraulic circuit is used to retract said rod into said chamber to lower said boom, said assist rod being simultaneously retracted within said interior, the compression of said compressible medium increasing actual pressure within said dynamic chamber and generating a potential energy therein, said assist cylinder being configured to convert said potential energy to kinetic energy that assists the subsequent raising of said boom when said hydraulic circuit is used to

extend said rod from said chamber, said hydraulic circuit expending less energy as a result of the kinetic energy used in said assist cylinder to extend said assist rod and exert a generally upward force to said boom at said first end.

27. The system of claim 2 wherein said first and second ends and said upper and lower ends comprise eyes.

28. The system of Claim 27 wherein each said eye comprises a bearing.

29. The system of Claim 28 wherein each said bearing is configured to receive a pin sized between about two inches and about six inches in diameter.